

The Search for New Medicines

Objectives

After this lesson, students will be able to

E.3.4.1 Identify one reason why medical researchers want to protect biodiversity.

E.3.4.2 Explain why many rain forest plants are sources of medicines.

Target Reading Skill

Asking Questions Explain that changing a head into a question helps students anticipate the ideas, facts, and events they are about to read.

Answers

Possible questions and answers are these:

Why is biodiversity important to medicine? (*Biodiversity is important because there may be undiscovered medicines that exist in nature.*) **What is the story of taxol?** (*Taxol is a cancer treatment drug that comes from the bark of the Pacific yew tree. As demand for the drug grew, scientists became concerned about the supply of Pacific yew trees.*) **How can we increase the supply of taxol?** (*Today taxol can be reproduced in the lab.*)

All in One Teaching Resources

- [Transparency E26](#)

Preteach

Build Background Knowledge

Temperate Rain Forests

Before students read the introductory text, ask: **Where are temperate rain forests located?** (*Along the northwest coast of the United States.*) If students have difficulty locating the temperate rain forests, direct their attention to the biome map in Ecosystems and Biomes. Then, have them match the legend with the location on the map.

The Search for New Medicines

Reading Preview

Key Concepts

- What is one reason why medical researchers want to protect biodiversity?
- Why are many rain forest plants sources of medicines?

Key Term

- taxol

Target Reading Skill

Asking Questions Before you read, preview the red headings. In a graphic organizer like the one below, ask a *what*, *how*, *who*, *when*, or *where* question for each heading. As you read, write the answers to your questions.

The Search for New Medicines

Question	Answer
Why is biodiversity important to medicine?	Biodiversity is important to medicine because . . .



For: Links on medicines from plants
Visit: www.SciLinks.org
Web Code: scn-0534



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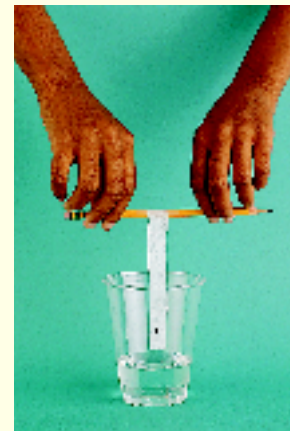
Download a worksheet that will guide students' review of Internet resources on medicines from plants.



Discover Activity

How Are Plant Chemicals Separated?

1. Using a black marking pen, draw a dot about 2 centimeters from the end of a strip of filter paper.
2. Pour a few centimeters of water into a clear plastic cup.
3. Tape the top edge of the filter paper strip to a pencil. Place the pencil across the top of the cup so that the ink dot hangs just below the water surface. If necessary, turn the pencil to adjust the length of the paper.
4. Observe what happens to the black dot.



Think It Over

Observing How many different colors of ink did you separate from the black ink? This process models one way of separating individual chemicals contained in plants.

You lace up your hiking boots and sling your collecting bag over your shoulder. It's time to head out for another day of searching in the cool, damp forest. Stepping carefully to avoid mud, you walk beneath giant evergreens. Their needle-covered branches form a thick roof above your head. Rotting logs covered with ferns, seedlings, and brightly colored fungi line your path. You scan the area for telltale signs of the object of your search. What are you searching for? A plant that can save lives!

This ancient forest is the temperate rain forest of the Pacific Northwest. Many of its giant trees are more than 200 years old. Like tropical rain forests, temperate rain forests are diverse ecosystems. They contain many species that are found nowhere else. Some of these species are rare or endangered, including the bull trout, Olympic salamander, and the life-saving plant you are looking for—the Pacific yew tree.



Discover Activity

Skills Focus Observing

Materials black marking pen, strip of filter paper, water, clear plastic cup, tape, pencil

Time 15 minutes

Tips If filter paper is not available, use white paper towels cut into strips.

L1

Expected Outcome Water will carry the dissolved black ink up the strip, where the individual colors will separate out.

Think It Over The specific colors that separate from the black ink will depend on the marker used. Different colors will travel up the strip at different rates—blue the fastest, yellow slightly slower; and red much slower.

Biodiversity and Medicine

Teach Key Concepts

L2

Identifying the Relationship

Focus Direct students' attention to the photos on the page. Ask students if they are familiar with any of the organisms shown.

Teach Ask: **What is the relationship between biodiversity and medicine?** (*People have always studied plants for their ability to heal wounds, fight diseases, and ease pain. Almost half of all medicines sold today contain chemicals originally found in wild organisms.*)

Extend Encourage students to ask older family members about plant remedies.
learning modality: verbal

Independent Practice

All in One Teaching Resources

- [Guided Reading and Study Worksheet: The Search for New Medicines](#)

 **Student Edition on Audio CD**

Monitor Progress

L2

Skills Check Have students write a paragraph that explains why biodiversity is important to medicine. Students can place their paragraphs in their portfolios.



Answers

Figure 18 Extinction would mean a species is no longer available. Any drugs that could have been developed from it would be lost.

 **Reading Checkpoint** Bark of the willow tree

Biodiversity and Medicine

People have always studied plants for their ability to heal wounds, fight diseases, and ease pain. For example, aspirin was originally made from the bark of the willow tree. The active chemical in aspirin can now be made in a laboratory.

Almost half of all medicines sold today contain chemicals originally found in wild organisms. For example, digitalis, a medication used to treat certain heart problems, comes from the leaves of the foxglove, a common garden plant. The study of another plant, the Madagascar rosy periwinkle, has produced two effective cancer treatments. From this flowering plant, researchers have produced vincristine, a medication for childhood leukemia, and vinblastine, a medication for Hodgkin's disease.

What other medicines exist undiscovered in Earth's forests, oceans, and other locations? **In 1995, the American Medical Association called for the protection of Earth's biodiversity. Their goal was to preserve the undiscovered medicines that may exist in nature.** Governments, scientists, and private companies are working together to find new species and study known species all over the world. They are working hard to find new sources of disease-fighting drugs.

 **Reading Checkpoint** From what plant was aspirin originally made?

FIGURE 18
Biodiversity and Medicine
Scientists study organisms to identify new sources of disease-fighting medicines. **Predicting** How could the extinction of species affect the search for new medicines?

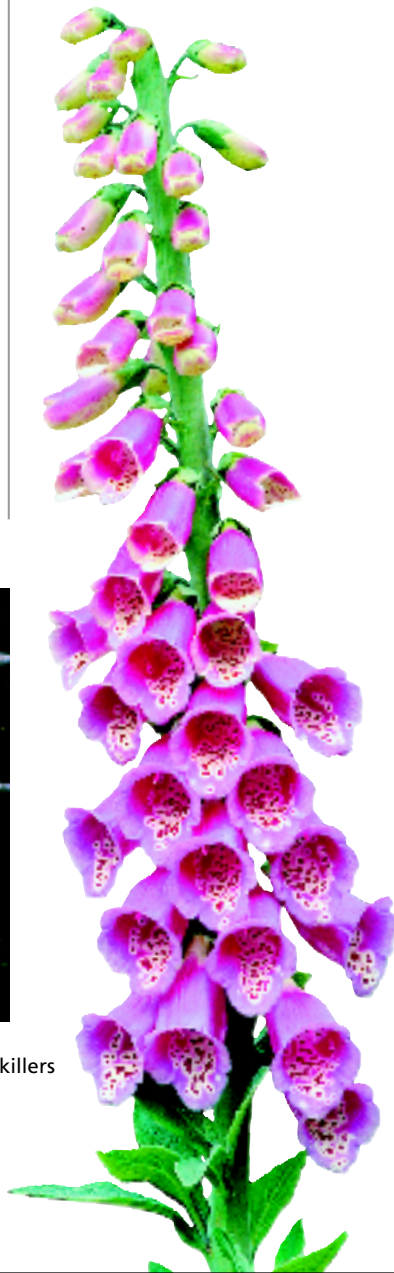


▲ **Madagascar Rosy Periwinkle:**
source of cancer treatments



▲ **Longsnout Seahorse:**
possible source of painkillers and cancer treatments

▼ **Foxglove:**
source of heart medication



Differentiated Instruction

Gifted and Talented

Traditional Folk Remedies Have students examine labels from a variety of herbal teas, such as chamomile, St. John's wort, ginseng, kava kava, echinacea, ginkgo biloba, and cat's claw, to find out the source

L3

of the ingredients for each type of tea and the tea's purported benefits. Have them note that the product is not approved by the FDA for medical use. **learning modality: logical/mathematical**

The Story of Taxol

Teach Key Concepts

L2

Taxol Today

Focus Tell students that the Pacific yew is a conifer that grows in temperate rain forests.

Teach Explain that scientists studied the Pacific yew because it is so resistant to many diseases and insects. Ask: **How is taxol used medically?** (*To treat cancer*) **How has the production of taxol changed since it was first discovered?** (*At first, it was made from the bark of the Pacific yew; now it is made in a laboratory.*)

Apply Tell students that thousands of people are treated with taxol each year. Ask: **How many Pacific yews would have to be cut down to treat a thousand people?** (*3,000*) Point out that making taxol in the laboratory has ensured a good supply of taxol and saved thousands of Pacific yews. **learning modality: logical/mathematical**

Integrating Health

L2

Taxol was first tested in women with ovarian cancer that had not responded to chemotherapy and radiation. Ovarian tumors in 40 percent of the women shrank to half their original size. When taxol was later given to women with breast cancer, more than half the patients experienced partial remission. Ask: **Why do you think taxol was first tested on women whose cancer did not respond to traditional therapies?** (*There was no other choice available. Since traditional therapies had failed, this experimental drug was the only hope for these patients.*) **learning modality: verbal**



FIGURE 19

Pacific Yew Tree

While studying the Pacific yew's resistance to disease and insects, scientists discovered taxol.

Developing Hypotheses *Why might Pacific yew trees need such strong resistance?*

The Story of Taxol

Plants in many ecosystems can produce chemicals that protect them from predators, parasites, and diseases. This ability results from the plants' adaptations to their environment. In rain forests, where so many organisms eat plants, plants have many adaptations that protect them. **Some protective chemicals that rain forest plants produce can also be used to fight human diseases.**

The Pacific Yew The Pacific yew tree grows in the temperate rain forest. It is unusually resistant to the many diseases and insects found there. Scientists began to study the bark of the Pacific yew to find out why it was so hardy. When they separated the various chemicals found in the bark, they discovered unusual crystals. These crystals are made from a chemical called **taxol**, the substance that protects the Pacific yew tree.

Taxol as a Cancer Treatment Scientists conducted experiments with taxol in the laboratory. The experiments showed that taxol crystals affect cancer cells in an unusual way. Typically, cancer cells grow and divide very rapidly. This quick growth forms a mass of cells called a tumor. When cancer cells are exposed to taxol, the taxol forms structures that look like tiny cages around each cancer cell. These structures prevent the cancer cells from dividing. As a result, the cancer cannot grow and spread.

After more research, doctors were ready to test taxol on cancer patients. The taxol treatments often were able to shrink certain types of tumors. Sometimes they even stopped the cancer from spreading in the body. Taxol is now used to treat thousands of cancer patients each year.



FIGURE 20

Cancer Survivors

These women are breast cancer survivors. Some of them probably received taxol as a treatment.

The Supply of Taxol As the demand for taxol rapidly grew, many scientists became concerned about the supply of Pacific yew trees. The bark of three Pacific yew trees was required to produce enough pure taxol for just one cancer patient's treatment. Without its bark, a yew cannot survive. Also, by the time researchers discovered taxol's value as a cancer-fighting drug, large portions of the temperate rain forests where yew trees grow were gone.

Today, the bark of the Pacific yew is no longer used in the manufacture of taxol. Chemists worked for many years to reproduce taxol's complex chemical structure in the laboratory, and they finally succeeded in the mid-1990s. This discovery ensured a good supply of taxol for the future. It also helped protect the remaining Pacific yew trees for future generations.



Why was it important for scientists to find a way to make taxol in the laboratory?



FIGURE 21

Supply of Taxol

Because of its complex chemical structure, it took scientists many years to create taxol in the laboratory.

Monitor Progress L2

Skills Check Ask students to summarize how taxol was developed as a cancer drug.

Answers

Figure 19 The Pacific yew tree grows in the temperate rain forest where many diseases and insects are found.



The demand for taxol from trees exceeded the yield, and harvesting the bark destroyed the trees.

Assess

Reviewing Key Concepts

- The goal was to preserve undiscovered medicines that might exist in nature.
 - No; many parts of the rain forest remain unexplored so it is likely that there are medicinal plants to be discovered.
 - The extinction of wild plants provides medical researchers with fewer possible sources of medicine.
- They produce chemicals that protect them from predators, parasites, and diseases. These same chemicals can be used to fight human diseases.
 - The Pacific yew tree is the source of taxol, which protects the tree from diseases and insects in its environment.
 - Taxol forms structures around cancer cells that prevent the cancer cells from dividing. In both cancer patients and the yew tree, taxol protects against disease.

Reteach L1

Have students place the phrases *logging and development of temperate rain forest*, *declining biodiversity*, and *lower possibility of finding plant-based medicines* in a cause-and-effect graphic organizer.

Performance Assessment L2

Oral Presentation Have students tell the taxol story.

All in One Teaching Resources

- [Section Summary: The Search for New Medicines](#)
- [Review and Reinforcement: The Search for New Medicines](#)
- [Enrich: The Search for New Medicines](#)

Section 4 Assessment

Target Reading Skill Asking Questions Use the answers to the questions you wrote about the headings to help you answer the questions below.

Reviewing Key Concepts

- Reviewing** Why did the American Medical Association call for the protection of Earth's biodiversity?
 - Inferring** Do you think that scientists have identified all the wild plants that may have medical uses? Why or why not?
 - Predicting** Suppose many wild plants were to become extinct within a short time. What effect might this have on medical research? Explain your answer.
- Identifying** What adaptations of rain forest plants make them likely sources of medicines?
 - Explaining** What plant is the source of taxol, and what is the function of taxol in this plant?
 - Comparing and Contrasting** What is the effect of taxol on cancerous tumors? In what way is this effect similar to the function of taxol in the plant?

Writing in Science

News Report Suppose that you were a health news reporter at the time taxol became available as a cancer treatment. Write a two-paragraph news report about taxol. In the first paragraph, discuss the discovery of taxol. In the second paragraph, describe how taxol stops cancer from spreading.



Chapter Project

Keep Students on Track As students observe their plots, encourage them to draw the organisms in detail so that they can identify them later using field guides. Remind students to make notes about abiotic factors as well. Check each group's notebook occasionally to make sure students are recording data.

Writing in Science

Writing Skill News Report

Scoring Rubric

- Includes detailed and accurate information with engaging and newsy style
- Includes complete and accurate information
- Includes incomplete information and some inaccuracies
- Includes incomplete or inaccurate information

